

Science

Assessment Plan  
2002

# **New Assessment Plan Tentative Timeline**

**(Elementary, Middle, and High School)**

**Michigan State Board of Education**

**Superintendent of Public Instruction**

**Michigan Educational Assessment Program  
Standards, Assessment and Accreditation**

**Technical Advisory Committee**

## **Content**

The assessments  
will be based on  
the State Board  
of Education  
Content  
Standards  
Approved July  
1995

English/Language  
Arts  
(reading, writing,  
listening)  
Mathematics  
Science

## **Plan for Statewide Assessments**

Committees of subject  
area experts  
including  
teachers, curriculum  
coordinators,  
administrators and  
others will develop  
the plan.

Focus Groups  
District Reviews  
Field Reviews  
Revisions

Present to SBE

Fall 1998

## **Test Development**

RFP/Contract  
and Bidding

Identify  
Contractor

Exercise  
Development

Content Advisory  
Committees will  
review test questions

Bias Review  
Committee will  
review test questions

Spring 1999

## **Item Tryouts**

Statewide tryout  
of potential test  
items

Item revision  
based on tryout  
results

Fall 2000

## **Test Pilots**

Statewide pilot  
of test forms

Final revisions  
to test items  
based on pilot  
results

Winter 2001

## **First Administration**

**Winter 2002**

**2002 Plan: Minutes Required for Testing**

	<b>Science</b>	<b>Mathematics</b>	<b>English Language Arts</b>	<b>Social Studies*</b>	<b>Total</b>
<b>11th Grade</b>	<b>100</b>	<b>100</b>	<b>180</b>	<b>100</b>	<b>480</b>
<b>8th Grade</b>	<b>100</b>	<b>100</b>		<b>100</b>	<b>300</b>
<b>7th Grade</b>			<b>180</b>		<b>180</b>
<b>5th Grade</b>	<b>90</b>			<b>100</b>	<b>190</b>
<b>4th Grade</b>		<b>90</b>	<b>180</b>		<b>270</b>

**\* Begins in 1999; no changes in 2002.**

# **Assessment Plan: Science**

## **I. Assessment Plan Description**

### **A. Structure of the Assessment Plan**

This document consists of a plan for assessment of Science. Each subject matter area has a different plan although their structure is similar and planned development schedules are identical. Each subject area plan was developed by a subject area specific committee, but each committee used the same approach to determine its assessment plan.

The plans reflect the translation of content standards into assessment specifications through examination of the assessable content in light of sound measurement principles. The central part of each plan is the specification of the form of the assessment. The plan will also include some item prototypes, reaction from the field to the specifications, schedule for implementation, and a process for accomplishing the development of the assessment.

The list below indicates the major components of the Science Assessment Plan. A brief description of each component is also included. Each component represents an important aspect of the assessment. Together the components serve to define the form and nature of the assessment.

#### **Assessable Content**

The assessable content forms the basis for the assessment. This content universe defines what domain is to be assessed. The validity of the assessment is defined by this content. Curriculum frameworks define the content that is included in instruction. The assessable content is more specific and defines that part of the content that will be included on the assessment.

#### **Assessment Specifications**

The assessment plan contains specifications for the structure of the assessment. These include a description of how long the assessment is, how many test items and exercises are given, and what those items and exercises look like. The assessment specifications also include the test blueprint, which indicates the emphasis of assessment item type and the content which is assessed by each item type.

## Item Prototypes

Example items or prototypes are included in the assessment plan. These can be used as examples of actual assessment items to illustrate what the assessment will look like. These are especially useful for review purposes in the schools and for the public. These item prototypes will not be totally representative of the assessable content, but will attempt to present a breadth of assessment types for examination.

## Content and Specification Analysis Survey

A survey of the educational community will be included. The survey will solicit the reaction of educators to the assessable content, assessment specifications, and item prototypes. This feedback will be used to refine the assessment plan document. The survey can be used to inform the schools as well as collect information from educators.

## Development Process

The assessment plan contains a plan for development of the assessment. This will include the steps necessary to build the assessment and a schedule for implementation. The description of the development process helps to illustrate the processes put into place to guarantee the validity, reliability, and utility of the assessment. It also informs the school user and public of the procedures used to develop a fair and useful assessment program.

## **B. Process for Development of the Science Assessment Plan**

The translation of content standards into assessment specifications is the responsibility of the content committee. Their work was guided by assessment experts. It was important that the instructional aspects of these assessments be taken into consideration early in the process. The committee was also extremely helpful in determining the information that is to be produced by the assessment.

The assessment plan committee consisted of educators, content experts, and members of the public. The twenty or so individuals were selected because of their knowledge of the subject matter and experience in education in the content area. Committee members were asked to review the curriculum frameworks in order to determine the assessable content. They were also asked to determine assessment blueprints and specifications. Committee members worked on the development of item prototypes.

The committee met five times to determine the major parts of the assessment plan. A list of the committee meetings and the major tasks is listed below.

Meeting 1 Review of the Content and Introduction to Task  
1 Day

Meeting 2 Definition of Assessable Content  
1 Day

Meeting 3 Score Type and Report Definitions  
2 Days

Meeting 4 Review of Assessment Specifications  
1 Day

Meeting 5 Development of Item Prototypes  
1 Day

### **C. Purposes of the Assessment Plan**

The assessment plan serves the four purposes listed below. The document is useful for informing the education community of the assessment characteristics early in the process. It is also very useful in communicating specifically to potential contractors the scope of work in the development process. The process of developing the plan will allow that major stakeholders in assessment and instruction agree on the nature and feasibility of the assessment before the development process begins.

#### **Alignment of Instructional and Assessment Purposes**

The assessment plan allows early in the process for the examination of the alignment of instruction to assessment. Too often assessment is created that does not emphasize the important parts of the instructional sequence. This document serves to illustrate how the curriculum frameworks are related to the assessable content and assessment specifications.

#### **Review Document for Planning and Approval**

This document serves as a complete description of the assessment. Often many decisions are made about assessments without a complete picture of the final assessment process and how the assessment fits with the instructional goals. The assessment plan can be used as documentation for the complete assessment as well as a approval and review document.

## Documentation for the Public and Schools

Once the assessment plan has been approved and review is completed it can serve as the basis for a document to inform the schools and public about the upcoming assessment program. The assessment plan essentially becomes a guidebook to the assessment. As assessments become more important to the schools, clear communication of their nature, format, characteristics, and purpose becomes very important.

## Task Description for the Request for Proposal

The assessment plan will serve as an excellent document to inform potential contractors of the nature and form of the new assessment program. The description of the assessable content, assessment specifications, and item prototypes will allow bidders to respond to concrete information about the assessment. This information should insure a more efficient bidding process and better pricing.

## **Assessable Content**

The assessable content was derived from the Michigan Curriculum Framework and is based on that document. All content that is defined as assessable can be found in the Michigan Curriculum Framework. The assessable content at each grade is a subset of that curriculum framework.

The content defined as assessable is the basis for determining what the scores on any achievement assessment mean. The definition of this content determines the assessment's validity. When scores from this assessment are used they will derive their meaning from the assessable content. This is the definition of what this test measures.

The Science Assessment Plan Committee did a complete review of the curriculum framework and identified the content to be included in the assessable content. The definition of assessable content follows the same structure as the curriculum framework and differs only slightly in scope. The committee did identify areas within the Michigan Curriculum Framework that would not be assessed in the census assessment. These are noted in the Assessable Content that follows.

Content that was not included in the assessable content was identified for two basic reasons. Either the content was beyond the level to be assessed or the content could not be optimally assessed by a paper and pencil assessment instrument in the time frame possible for state testing. The committee made an effort to include as much of the Michigan Curriculum Framework content as could be accommodated.

# Science Assessment Specifications

## A. General Characteristics

Science will be assessed at the Elementary, Middle, and High school levels. Multiple-choice and constructed-response items will be used to assess the content. Science is organized by content strand in the curriculum framework and the test blueprint is organized along those content classifications. Within strand classifications the content is organized by standard and then for each standard there are a set of benchmarks. Almost all standards will be assessed on each assessment. Although items will be written for a benchmark, the narrative sections of the Michigan Essential Goals and Objectives for Science Education (MEGOSE) will continue to be used as a reference.

Assessment time will be limited to 90-100 minutes of actual testing time, depending on school level.

## B. Assessment Blueprint

### Elementary School Level-Content Emphasis

<b>STRAND</b>	<b>Percent*</b>
Constructing New Knowledge	30
Reflecting on Scientific Knowledge	10
Using Life Science Knowledge	20
Using Physical Science Knowledge	20
Using Earth and Space Science Knowledge	20

\*Percent is the percentage of total points on the test devoted to each strand.

### Elementary School-Item Type Balance

	<b>Items</b>	<b>Points</b>	<b>Percent</b>
Multiple-Choice 1 point each	37	37	62
Constructed-Response 3-4 points each	7	23	38
Total Assessment	44	60	100



### Elementary School-Question Type Balance

<b>Cluster Problems</b>	<b>Multiple-Choice</b>	<b>Constructed Response/Points</b>
Life Science	3	1/3
Physical Science	3	1/3
Earth and Space Science	3	1/3
Integrated*	3	1/3
Integrated	3	1/3
Investigation	3	1/4
Text Criticism	3	1/4
<b>Individual Questions</b>		
Individual Multiple-Choice	16	
<b>Total</b>	<b>37</b>	<b>7/23</b>

\*Note: There will be two Integrated clusters on the test.

### Middle School Level-Content Emphasis

<b>STRAND</b>	<b>Percent*</b>
Constructing New Knowledge	25
Reflecting on Scientific Knowledge	15
Using Life Science Knowledge	20
Using Physical Science Knowledge	20
Using Earth and Space Science Knowledge	20

\*Percent is the percentage of total points on the test devoted to each strand.

### Middle School-Item Type Balance

	<b>Items</b>	<b>Points</b>	<b>Percent</b>
Multiple-Choice 1 point each	43	43	57
Constructed-Response 3-4 points each	10	32	43
<b>Total Assessment</b>	<b>53</b>	<b>75</b>	<b>100</b>

### Middle School-Question Type Balance

<b>Cluster Problems</b>	<b>Multiple-Choice</b>	<b>Constructed-Response/Points</b>
Life Science*	3	1/3
Life Science	3	1/3
Physical Science	3	1/3
Physical Science	3	1/3
Earth and Space Science	3	1/3
Earth and Space Science	3	1/3
Integrated	3	1/3
Integrated	3	1/3
Investigation	3	1/4
Text Criticism	3	1/4
<b>Individual Questions</b>		
Individual Multiple-Choice	13	
<b>Total</b>	<b>43</b>	<b>10/32</b>

\*Note: There will be two Life, Physical, Earth and Space, and Integrated clusters on the test.

### High School Level-Content Emphasis

<b>STRAND</b>	<b>Percent*</b>
Constructing New Knowledge	20
Reflecting on Scientific Knowledge	20
Using Life Science Knowledge	20
Using Physical Science Knowledge	20
Using Earth and Space Science Knowledge	20

\*Percent is the percentage of total points on the test devoted to each strand.

### High School-Item Type Balance

	Items	Points	Percent
Multiple-Choice 1 point each	43	43	57
Constructed-Response 3-4 points each	10	32	43
Total Assessment	53	75	100

### High School-Question Type Balance

Cluster Problems	Multiple-Choice	Constructed-Response/Points
Life Science*	3	1/3
Life Science	3	1/3
Physical Science	3	1/3
Physical Science	3	1/3
Earth and Space Science	3	1/3
Earth and Space Science	3	1/3
Integrated	3	1/3
Integrated	3	1/3
Investigation	3	1/4
Text Criticism	3	1/4
<b>Individual Questions</b>		
Individual Multiple-Choice	13	
Total	43	10/32

\*Note: There will be two Life, Physical, Earth and Space, and Integrated Clusters on the test.

## **D. Score Reporting**

Detailed score reporting specifications will need to be formulated after the assessment is completed, however recommendations for the types of scores needed can be made based on the assessment blueprint. Reported scores must demonstrate validity and reliability. This constraint restricts the amount of information that can be provided from a relatively short assessment of this nature.

For individuals a total score in Science achievement should be provided. Strand scores can be provided by individual also, except where content coverage is limited. This would be the case where less than ten percent of the points were devoted to a particular strand. Scores at the strand level will not be extremely reliable and will need to be interpreted as comparisons to a standard or a norm group. They also will not be comparable in raw score terms over test administrations.

Schools and districts can receive the same data as for students in the aggregate. Schools and districts also will be able to get data at the standard (when at least 5 points are available for a standard) and item level in the form of item analysis at the elementary and middle school levels. High school item analysis is not available for test security reasons, but standard level scores could be provided for schools and districts.

## **Item Prototypes**

Assessment Plan committees worked to produce item prototypes in order to illustrate the types of assessment exercises that were envisioned. Two types of assessment exercises were proposed for the assessment. Multiple-choice test items would be used in all content areas as well as open-ended exercises. The type of open-ended item varied somewhat by content area.\*

Item prototypes were developed to give examples of exercises. The prototypes have been produced across content areas and item types within each subject. The following prototypes are not meant to be representative of the assessment content or the focus on particular content areas. These prototypes should be useful to reviewers of this plan in order to get a sense of the item exercises. These items are in the prototype stage and may change. They also have not undergone a complete development process and have not been subject to actual testing conditions. They are presented as examples of possible assessment exercise types and not as actual test items.

\* Although items will be written for a benchmark, the narrative sections of the Michigan Essential Goals and Objectives for Science Education (MEGOSE) will continue to be used as a reference.

### C. General Scoring Guide

#### Science - 2002 Plan

Answer is correct and contains no extraneous or incorrect ideas.	Answer is essentially correct but contains some extraneous and/or incorrect information.	Answer is partially correct but contains significant errors.	Answer is incorrect.
All elements of the questions are all answered.	Most elements of the question are answered.	Only one element of the question is addressed.	Answer does not address elements of the question.
Answer is logical, with no contradictions and elaborates as needed on all relevant concepts/terms using supportive labels, drawings/diagrams as needed.	Answer is logical, no contradictions and elaborates on some concepts/terms. Diagrams may be incomplete or lacking labels.	Answer contains some contradictions and/or states terms without elaboration.	Answer lacks logic.
Answer is adequately supported by evidence/data or appropriately supported by example(s) of concepts described.	Answer partially supported by evidence/data or supported by some appropriate examples of concepts described.	Answer is supported with some inappropriate examples/data/evidence.	Answer is not supported.

## School Report - High School

School						District						State					
Exceeded Standards *	Met Standards	At Basic Level	Not Endorsed	Total Students Tested	Mean Scale Score	Exceeded Standards	Met Standards	At Basic Level	Not Endorsed	Total Students Tested	Mean Scale Score	Exceeded Standards	Met Standards	At Basic Level	Not Endorsed	Total Students Tested	Mean Scale Score
10%	12%	60%	18%	120	380	10%	13%	50%	27%	305	390	17%	28%	25%	30%	110,015	370

	Possible Points	Mean Points Earned by Students at or Above Level 3	School		District		State	
	57		Points Earned	% Correct	Points Earned	% Correct	Points Earned	% Correct
<b>Constructing</b>	12	9.2	8	66.7	6	50.0	9	75.0
<b>Reflecting</b>	14	8.0	7	50.0	7	50.0	10	71.4
<b>Life</b>	10	6.6	9	90.0	8	80.0	9	90.0
<b>Physical</b>	10	6.4	7	70.0	7	70.0	6	60.0
<b>Earth/Space</b>	11	9.3	8	72.7	6	54.5	9	81.8
<b>Total Mean Pts</b>		7.9	7.8		6.8		8.6	
<b>Standard 1</b>	5	4.3	4	80.0	3	60.0	3	60.0
<b>Standard 2</b>	5	1.8	2	40.0	3	60.0	3	60.0
<b>Standard 3</b>	5	2.4	3	60.0	4	80.0	5	100.0
<b>Standard 4</b>	4+	3.1	-	-	-	-	3	75.0
<b>Standard 5</b>	Not Tested	-	Not Tested	-	Not Tested	-	Not Tested	-
<b>Standard 6</b>	5	4.5	4	80.0	3	60.0	4	80.0

	Possible Points 57	Mean Points Earned by Students at or Above Level 3	School		District		State	
			Points Earned	% Correct	Points Earned	% Correct	Points Earned	% Correct
<b>Standard 7</b>	5	4.2	5	100.0	4	80.0	4	80.0
<b>Standard 8</b>	Not Tested	-	Not Tested	-	Not Tested	-	Not Tested	-
<b>Standard 9</b>	Not Tested	-	Not Tested	-	Not Tested	-	Not Tested	-
<b>Standard 10</b>	5	4.1	5	100.0	3	60.0	4	80.0
<b>Standard 11</b>	5	1.6	2	40.0	3	60.0	3	60.0
<b>Standard 12</b>	5	2.5	2	40.0	3	60.0	4	80.0
<b>Standard 13</b>	5	4.4	3	60.0	3	60.0	3	60.0
<b>Standard 14</b>	4 <sup>+</sup>	.9	-	-	-	-	4	100.0
<b>Standard 15</b>	4 <sup>+</sup>	2.1	-	-	-	-	3	75.0

\* Exceeded Michigan Standards - Need Scale Score of at least *xxx* for Level 1  
Met Michigan Standards - Need Scale Score between *xxx* and *xxx* for Level 2  
At Basic Level - Need Scale Score between *xxx* and *xxx* for Level 3

<sup>+</sup> Not enough points to report at the school and district levels

## District Report - High School

District						State					
Exceeded Standards *	Met Standards	At Basic Level	Not Endorsed	Total Students Tested	Mean Scale Score	Exceeded Standards	Met Standards	At Basic Levels	Not Endorsed	Total Students Tested	Mean Scale Score
10%	13%	50%	27%	305	390	17%	28%	25%	30%	110,015	370

	Possible Points	Mean Points Earned by Students at or Above Level 3	School		District		State	
	57		Points Earned	% Correct	Points Earned	% Correct	Points Earned	% Correct
Constructing	12	9.2			6	50.0	9	75.0
Reflecting	14	8.0			7	50.0	10	71.4
Life	10	6.6			8	80.0	9	90.0
Physical	10	6.4			7	70.0	6	60.0
Earth/Space	11	9.3			6	54.5	9	81.8
Total Mean Pts		7.9			6.8		8.7	
Standard 1	5	4.3			3	60.0	3	60.0
Standard 2	5	1.8			3	60.0	3	60.0
Standard 3	5	2.4			4	80.0	5	100.0
Standard 4	4+	3.1			-	-	3	75.0
Standard 5	Not Tested	-			Not Tested	-	Not Tested	-
Standard 6	5	4.5			3	60.0	5	100.0



	Possible Points	Mean Points Earned by Students at or Above Level 3	School		District		State	
	57		Points Earned	% Correct	Points Earned	% Correct	Points Earned	% Correct
<b>Standard 7</b>	5	4.2			4	80.0	4	80.0
<b>Standard 8</b>	Not Tested	-			Not Tested	-	Not Tested	-
<b>Standard 9</b>	Not Tested	-			Not Tested	-	Not Tested	-
<b>Standard 10</b>	5	4.1			3	60.0	4	80.0
<b>Standard 11</b>	5	1.6			3	60.0	3	60.0
<b>Standard 12</b>	5	2.5			3	60.0	4	80.0
<b>Standard 13</b>	5	4.4			3	60.0	3	60.0
<b>Standard 14</b>	4 <sup>+</sup>	.9			-	-	4	100.0
<b>Standard 15</b>	4 <sup>+</sup>	2.1			-	-	3	75.0

\* Exceeded Michigan Standards - Need Scale Score of at least xxx for Level 1  
Met Michigan Standards - Need Scale Score between xxx and xxx for Level 2  
At Basic Level - Need Scale Score between xxx and xxx for Level 3

+ Not enough points to report at the school and district levels

Michigan Department of Education  
Michigan Educational Assessment Program

**Science Assessment Planning Committee**

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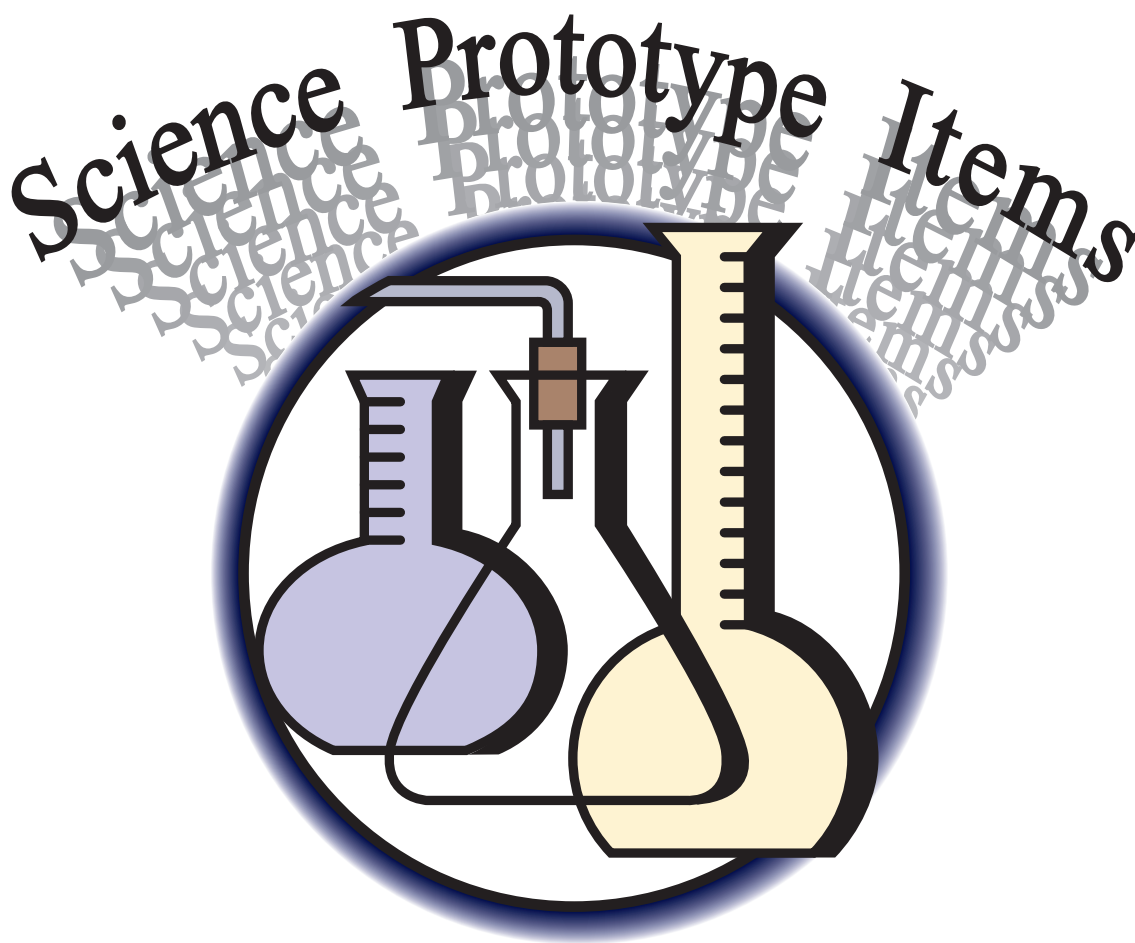
Dr. Catherine Smith  
Michigan Department of Education  
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Program

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# meap

Michigan Educational Assessment Program

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2001 - 2002 Assessment

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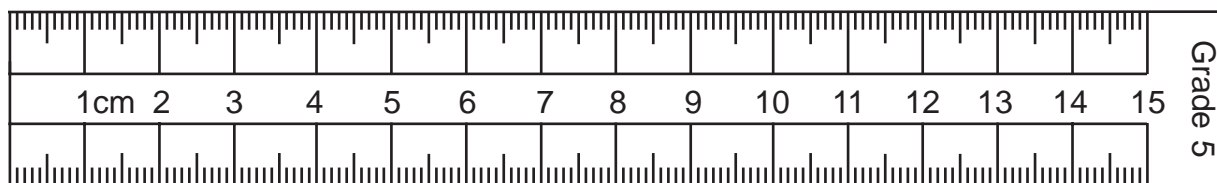
*Elementary School*

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Directions: Read the following paragraph and then answer questions 1 - 5.

Shannon's family has an electric popcorn popper. It heats air and blows the hot air on the popcorn kernels to make them pop.

- 1 What form of energy makes the popcorn popper operate?
  - A sound energy, because the popcorn makes a popping sound, and you hear the motor
  - B electrical energy, because electricity is used to heat the air and run the fan motor
  - C food energy, because the popcorn is food
  - D motion energy, because the popcorn moves when it pops
- 2 Shannon melted some butter in a pan on the stove to put on her popcorn. What form of energy made the butter melt?
  - A light energy
  - B heat energy
  - C food energy
  - D sound energy
- 3 What is the width of the popcorn kernel shown in the picture?



- A 5 mm                      B 10 cm                      C 5 cm                      D 7 mm

Directions: Read the following paragraph and use the following chart to answer questions 4 - 5.

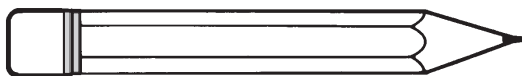
Shannon decided to compare different kinds of popcorn to find out which was the best buy. She bought three kinds of popcorn: regular white popcorn, regular yellow popcorn, and gourmet yellow popcorn. She put 50 kernels of each kind in the popper. She kept the popper running for each batch until the popcorn stopped popping. Then she counted the number of kernels of each kind that popped. Next, she put 25 popped kernels of each kind into a measuring cup to find out which kernels popped the biggest. Then she tasted some of each kind of popcorn. Her results are shown in the chart below.

Kind of popcorn	Number of kernels that popped	Volume of 25 popped kernels	Price for a 16-ounce bag	Shannon's taste test
regular white	38	60ml	\$1.19	OK
regular yellow	46	60ml	\$1.19	BEST
gourmet yellow	45	80ml	\$1.50	OK

- 4 Shannon's brother looked at her results and decided that the gourmet popcorn was the **BEST**. What evidence from the chart supports his decision?
- A There is no evidence from the chart to support his decision.
- B More of the gourmet popcorn popped.
- C There is more popcorn in the bag of gourmet popcorn.
- D The gourmet popcorn kernels popped the biggest.
- 5 Shannon decided that the regular yellow popcorn was the **BEST** popcorn. Identify two pieces of evidence from the chart that support her decision.

**ANSWER THIS ITEM IN YOUR ANSWER BOOKLET.**  
**NOTHING WRITTEN IN THE SPACE BELOW WILL BE SCORED.**

- 6 Louise investigated the parts of a pencil. She tested each part with a circuit to see if the materials were conductors or nonconductors of electricity. If a material is a conductor, the bulb will light. Her results are shown below. Which of the parts are made of a material that conducts electricity?



Part of Pencil	Bulb Lights
Eraser holder	Yes
Eraser	No
Wood part	No
Graphite point	Yes

- A only the eraser holder
- B the eraser holder and the graphite point
- C all of the parts
- D none of the parts
- 7 Joe put a cherry flavored cough drop in 150 ml of hot water and the same kind of cough drop in 150 ml of cold water. He observed that the cough drop in hot water dissolved faster. What question could Joe answer from this observation?
- A What kind of cough drop would be best for coughs?
- B How does the size of the cough drop affect how fast it will dissolve?
- C What effect does the water temperature have on dissolving cough drops?
- D What effect does the amount of water have on dissolving cough drops?

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*Middle School*

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Read the following paragraph and then answer questions 1 - 5.

Jamie was eating a sandwich for lunch and thinking about how her body uses food. She decided to do some research about what food is and what happens to it after she eats it.

- 1** Why was it important for Jamie to chew her sandwich before swallowing it?
    - A** Chewing helps the food stick together more efficiently.
    - B** Only bite-size pieces can pass through the stomach wall into the bloodstream.
    - C** Saliva and digestive juices can operate more efficiently on smaller pieces of food.
    - D** Chewing allows some of the food to be absorbed into the bloodstream.
  
  - 2** Jamie's sandwich had lettuce on it. What two words correctly describe Jamie and the lettuce?
    - A** consumer and producer
    - B** producer and decomposer
    - C** decomposer and producer
    - D** consumer and decomposer
  
  - 3** Which of the following represents the correct pathway of the nutrients in the food that Jamie has eaten?
    - A** circulatory system—> cells—> digestive system
    - B** circulatory system—> digestive system—> cells
    - C** digestive system—> circulatory system—> cells
    - D** cells—> digestive system—> circulatory system
-

- 4 Jamie decided to start running around the block twice each day. Her diet did not change, but she did notice a change in her weight at the end of a five-week period. The following table contains the information Jamie collected from her exercise experiment.

<b>Jamie's Weight Loss</b>
----------------------------

Week	Weight (lb)
1	120
2	119
3	118
4	117
5	117

Jamie concluded that running helped her lose weight. Do the results in the table support her conclusion?

- A Yes, because the data does show that Jamie lost weight.
- B Yes, because eating healthy foods helped Jamie lose weight.
- C Yes, because eating sandwiches affected Jamie's ability to exercise.
- D Yes, because the more times Jamie ran around the block each day, the more weight she lost.
- 5 The muscles in Jamie's legs use nutrients from the sandwich she ate. Describe one physical change and one chemical change food must go through before Jamie's body can use these nutrients.

**ANSWER THIS ITEM IN YOUR ANSWER BOOKLET.**  
**NOTHING WRITTEN IN THE SPACE BELOW WILL BE SCORED.**

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- 6 Julio mixed some orange powder with water to make an orange-flavored drink. As he stirred the drink, he noticed that the powder slowly disappeared. Which **BEST** explains what happened to the molecules making up the powder?

The **molecules** making up the powder

- A were dissolved by the liquid water.
- B were melted by the liquid water.
- C broke out of their arrangement and mixed in among the water molecules.
- D broke out of their arrangement and floated around in the liquid water.

Refer to the table of high and low temperatures and precipitation for a location in Michigan to answer question 7.

Date	High temp.	Low temp.	Precipitation
10-1	70	52	0.00
10-2	68	49	0.00
10-3	73	61	0.00
10-4	56	47	0.62
10-5	48	35	0.00
10-6	53	36	0.00
10-7	65	49	0.05

- 7 What event probably caused the rainfall on 10-4?
- A It is an example of lake effect rain.
  - B Longer nights cool the air, causing rain to condense.
  - C A cold front triggered rainfall.
  - D Rain from the south reached Michigan.
-

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# Constructed Response Rubrics

## Grade 5

“Yellow Popcorn the Best”

Scoring Guide:

2 = Two acceptable reasons

1 = One acceptable reason

0 = No acceptable reasons

Among the acceptable reasons:

Yellow popcorn had the largest # of kernels (46 out of 50) popped.

Yellow popcorn had the best taste.

Yellow popcorn is one of the cheaper kinds/is cheap.

## Grade 8

“Muscles in Jamie’s Legs”

Scoring Guide:

2 = One physical change **and** one chemical change

1 = One physical change **or** one chemical change

0 = An incorrect response

Among the acceptable physical changes are:

Jamie’s teeth break the food into smaller pieces

Nutrients are absorbed/dissolved into Jamie’s blood stream

The food was sliced, cut up, cooked, etc.

Among the acceptable chemical changes are:

The acid (juice) in Jamie’s stomach break the food down

Jamie’s saliva starts to break down the food

Enzymes help to break down the food

The food was cooked first

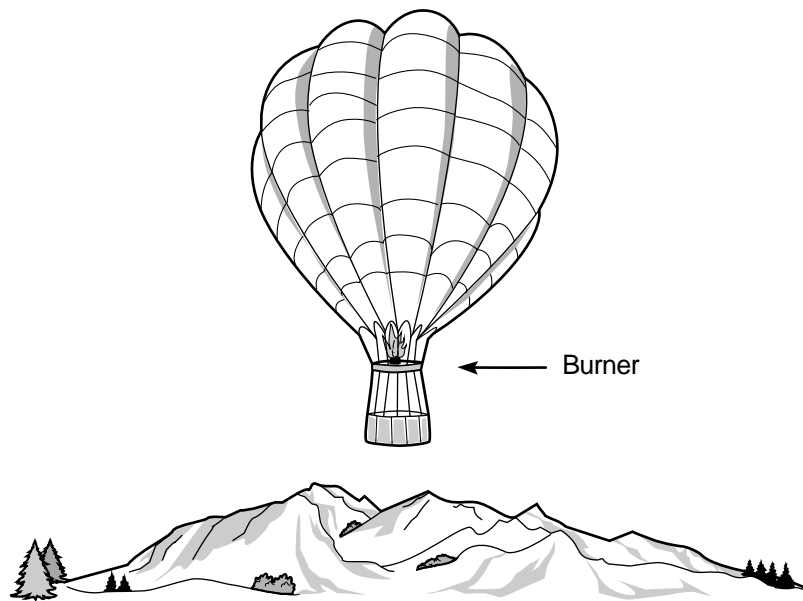
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*High School*

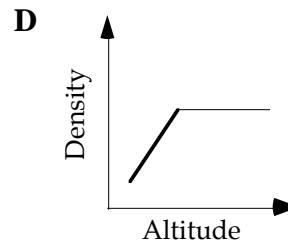
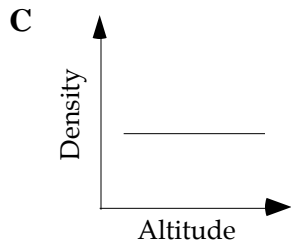
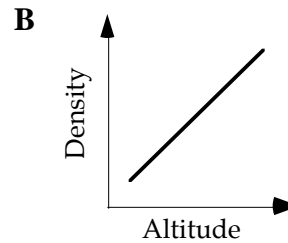
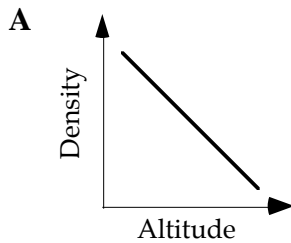
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The diagram shows a hot air balloon floating in the air. You can see the burner heating the air inside the balloon. Study the diagram. Then answer questions 1 through 4.



- 1 If the hot air balloon is floating—neither ascending nor descending—the mass of air displaced by the balloon must be
  - A less than the mass of the balloon.
  - B greater than the mass of the balloon.
  - C the same as the mass of the balloon.
  - D equal to an equivalent volume of water.
- 2 An inventor designed a device for hot air balloons that monitors the atmosphere as the balloon rises. As the air gets thinner and colder, the device signals the burner to produce more heat. This is an example of
  - A recycling.
  - B conservation.
  - C feedback control.
  - D mathematical constancy.

- 3 As altitude increases, the density of the air around the balloon decreases. Which graph below shows this relationship?



(2 points)

- 4 How does the temperature of the air inside the balloon affect the load that can be lifted by the balloon? In your response, be sure to include the concept of density.

**ANSWER THIS ITEM IN YOUR ANSWER DOCUMENT.  
NOTHING WRITTEN IN THE SPACE BELOW WILL BE SCORED.**

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# High School Test

## Constructed Response Rubric

### Key Elements:

#### A: Density/Volume

- The heated air in the balloon is less dense than the surrounding air.
- Volume of air in the balloon increases as the air is heated.
- The mass of the air displaced by the balloon must be greater or equal to the mass of the balloon in order for the balloon to be lifted or float.
- The mass of air inside the balloon decreases as cooler air is displaced out of the balloon.

#### B: Temperature/Bouyancy/Other

- The warmer the air inside the balloon, the greater the load that can be lifted.
- An increase in temperature of air inside the balloon will cause the balloon to rise.
- Balloon rises if gravitational force is less than the bouyant force.

### Score Points:

- 2 Points = Both **A** and **B** are given correctly.
  - 1 point = Either **A** or **B** are given correctly.
  - 0 points = Other
-



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# meap

Michigan Educational Assessment Program

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## Assessable Content

Content Standards and Benchmarks for Science



Elementary - Middle School - High School

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*Elementary School*

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**SCIENCE**  
***CONTENT STANDARDS AND BENCHMARKS***

**I. Construct New Scientific and Personal Knowledge**

**Content Standard 1: All students will ask questions that help them learn about the world; design and conduct investigations using appropriate methodology and technology; learn from books and other sources of information; communicate their findings using appropriate technology; and reconstruct previously learned knowledge. (Constructing New Scientific Knowledge)**

<b>Elementary</b>	<b>Testable</b>	<b>Restrictions</b>
1. Generate reasonable questions about the world based on observation.	YES	
2. Develop solutions to unfamiliar problems through reasoning, observation, and/or experiment.	YES	
3. Manipulate simple mechanical devices and explain how they work.	YES	
4. Use simple measurement devices to make metric measurement.	YES	
5. Develop strategies and skills for information gathering and problem solving.	YES	
6. Construct charts and graphs and prepare summaries of observations.	YES	

## **II. Reflect on the Nature, Adequacy and Connections Across Scientific Knowledge**

**Content Standard 1: All students will analyze claims for their scientific merit and explain how scientists decide what constitutes scientific knowledge; how science is related to other ways of knowing; how science and technology affect our society; and how people of diverse cultures have contributed to and influenced developments in science. (Reflecting on Scientific Knowledge)**

<b>Elementary</b>	<b>Testable</b>	<b>Restrictions</b>
1. Develop an awareness of the need for evidence in making decisions scientifically.	YES	
2. Show how science concepts can be interpreted through creative expression such as language arts and fine arts.	NO	
3. Describe ways in which technology is used in everyday life.	YES	
4. Develop an awareness of and sensitivity to the natural world.	YES	
5. Develop an awareness of contributions made to science by people of diverse backgrounds.	YES	

### III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

**Content Standard 1: All students will apply an understanding of cells to the functioning of multicellular organisms; and explain how cells grow, develop and reproduce. (Cells)**

Elementary	Testable	Restrictions
1. Describe cells as living systems.	NO	

**Content Standard 2: All students will use classification systems to describe groups of living things; compare and contrast differences in the life cycles of living things; investigate and explain how living things obtain and use energy; and analyze how parts of living things are adapted to carry out specific functions. (Organization of Living Things)**

Elementary	Testable	Restrictions
1. Compare and classify familiar organisms on the basis of observable physical characteristics.	YES	
2. Describe vertebrates in terms of observable body parts and characteristics.	YES	2. Don't use the term <u>invertebrate or vertebrate</u> in test questions.
3. Describe life cycles of familiar organisms.	YES	
4. Compare and contrast food, energy, and environmental needs of selected organisms.	YES	
5. Describe functions of selected seed plant parts.	YES	

**Content Standard 3: All students will investigate and explain how characteristics of living things are passed on through generations; explain why organisms within a species are different from one another; and explain how new traits can be established by changing or manipulating genes. (Heredity)**

Elementary	Testable	Restrictions
1. Give evidence that characteristics are passed from parents to young.	YES	

**Content Standard 4: All students will explain how scientists construct and scientifically test theories concerning the origin of life and evolution of species; compare ways that living organisms are adapted (suited) to survive and reproduce in their environments; and analyze how species change through time. (Evolution)**

Elementary	Testable	Restrictions
1. Explain how fossils provide evidence about the nature of ancient life.	YES	
2. Explain how physical and/or behavioral characteristics of organisms help them to survive in their environments.	YES	2. Don't use word <u>vertebrate</u> in test questions.

**Content Standard 5: All students will explain how parts of an ecosystem are related and how they interact; explain how energy is distributed to living things in an ecosystem; investigate and explain how communities of living things change over a period of time; describe how materials cycle through an ecosystem and get reused in the environment; and analyze how humans and the environment interact. (Ecosystems)**

Elementary	Testable	Restrictions
1. Identify familiar organisms as part of a food chain or food web and describe their feeding relationships within the web.	YES	1. Don't use concept of foodweb. Food chain is the only concept to be assessed.
2. Explain common patterns of interdependence and interrelationships of living things.	YES	2. Don't use words <u>symbiotic</u> or parasitic relationships on test.
3. Describe the basic requirements for all living things to maintain their existence.	YES	
4. Design systems that encourage growing of particular plants or animals.	YES	
5. Describe positive and negative effects of humans on the environment.	YES	

#### IV. Use Scientific Knowledge from the Physical Sciences in Real-World Contexts

**Content Standard 1: All students will measure and describe the things around us; explain what the world around us is made of; identify and describe forms of energy; and explain how electricity and magnetism interact with matter. (Matter and Energy)**

Elementary	Testable	Restrictions
1. Classify common objects and substances according to observable attributes: color, size, shape, smell, hardness, texture, flexibility, length, weight, buoyancy, states of matter, or magnetic properties.	YES	
2. Measure weight, dimensions, and temperature of appropriate objects and materials.	YES	
3. Identify properties of materials which make them useful.	YES	
4. Identify forms of energy associated with common phenomena.	YES	
5. Describe the interaction of magnetic materials with other magnetic and non-magnetic materials.	YES	
6. Describe the interaction of charged materials with other charged or uncharged materials.	YES	
7. Describe possible electrical hazards to be avoided at home and at school.	YES	

**Content Standard 2: All students will investigate, describe and analyze ways in which matter changes; describe how living things and human technology change matter and transform energy; explain how visible changes in matter are related to atoms and molecules; and how changes in matter are related to changes in energy. (Changes in Matter)**

Elementary	Testable	Restrictions
1. Describe common physical changes in matter—size, shape, melting, freezing, dissolving.	YES	
2. Prepare mixtures and separate them into their component parts.	YES	2. Don't use the words <u>sieves</u> , <u>distillations</u> , or <u>solar stills</u> .

Elementary	Testable	Restrictions
3. Construct simple objects that fulfill a technological purpose.	YES	

**Content Standard 3: All students will describe how things around us move and explain why things move as they do; demonstrate and explain how we control the motions of objects; and relate motion to energy and energy conversions. (Motion of Objects)**

Elementary	Testable	Restrictions
1. Describe or compare motions of common objects in terms of speed and direction.	YES	
2. Describe how forces (pushes or pulls) are needed to speed up, slow down, stop, or change the direction of a moving object.	YES	
3. Use simple machines to make work easier.	YES	

**Content Standard 4: All students will describe sounds and sound waves; explain shadows, color, and other light phenomena; measure and describe vibrations and waves; and explain how waves and vibrations transfer energy. (Waves and Vibrations)**

Elementary	Testable	Restrictions
1. Describe sounds in terms of their properties (pitch, loudness).	YES	
2. Explain how sounds are made.	YES	
3. Describe light from a light source in terms of its properties.	YES	
4. Explain how light illuminates objects.	YES	
5. Explain how shadows are made.	YES	



**V. Use Scientific Knowledge from the Earth and Space Sciences  
in Real-World Contexts**

**Content Standard 1: All students will describe the earth's surface; describe and explain how the earth's features change over time; and analyze effects of technology on the earth's surface and resources. (Geosphere)**

<b>Elementary</b>	<b>Testable</b>	<b>Restrictions</b>
1. Describe major features of the earth's surface.	YES	
2. Recognize and describe different types of earth materials.	YES	
3. Explain how rocks and fossils are used to understand the history of the earth.	YES	
4. Describe natural changes in the earth's surface.	YES	
5. Describe uses of materials taken from the earth.	YES	
6. Demonstrate means to recycle manufactured materials and a disposition toward recycling.	YES	

**Content Standard 2: All students will demonstrate where water is found on earth; describe the characteristics of water and how water moves; and analyze the interaction of human activities with the hydrosphere. (Hydrosphere)**

<b>Elementary</b>	<b>Testable</b>	<b>Restrictions</b>
1. Describe how water exists on earth in three states.	YES	
2. Trace the path that rain water follows after it falls.	YES	
3. Identify sources of drinking water.	YES	
4. Describe uses of water.	YES	

**Content Standard 3: All students will investigate and describe what makes up weather and how it changes from day to day, from season to season and over long periods of time; explain what causes different kinds of weather; and analyze the relationships between human activities and the atmosphere. (Atmosphere and Weather)**

Elementary	Testable	Restrictions
1. Describe the atmosphere.	YES	
2. Describe weather conditions and climates.	YES	2. Eliminate concept about climates.
3. Describe seasonal changes in weather.	YES	
4. Explain appropriate safety precautions during severe weather.	YES	

**Content Standard 4: All students will compare and contrast our planet and sun to other planets and star systems; describe and explain how objects in the solar system move; explain scientific theories as to the origin of the solar system; and explain how we learn about the universe. (Solar System, Galaxy and Universe)**

Elementary	Testable	Restrictions
1. Describe the sun, moon and earth.	YES	
2. Describe the motions of the earth and moon around the sun.	YES	

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*Middle School*

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**SCIENCE**  
**CONTENT STANDARDS AND WORKING DRAFT BENCHMARKS**

**I. Construct New Scientific and Personal Knowledge**

**Content Standard 1: All students will ask questions that help them learn about the world; design and conduct investigations using appropriate methodology and technology; learn from books and other sources of information; communicate their findings using appropriate technology; and reconstruct previously learned knowledge. (Constructing New Scientific Knowledge)**

<b>Middle School</b>	<b>Testable</b>	<b>Restrictions</b>
1. Generate scientific questions about the world based on observation.	YES	
2. Design and conduct simple investigations.	YES	
3. Investigate toys/simple appliances and explain how they work, using instructions and appropriate safety precautions.	YES	
4. Use measurement devices to provide consistency in an investigation.	YES	
5. Use sources of information to help solve problems.	YES	
6. Write and follow procedures in the form of step-by-step instructions, recipes, formulas, flow diagrams, and sketches.	YES	

## **II. Reflect on the Nature, Adequacy and Connections Across Scientific Knowledge**

**Content Standard 1: All students will analyze claims for their scientific merit and explain how scientists decide what constitutes scientific knowledge; how science is related to other ways of knowing; how science and technology affect our society; and how people of diverse cultures have contributed to and influenced developments in science. (Reflecting on Scientific Knowledge)**

<b>Middle School</b>	<b>Testable</b>	<b>Restrictions</b>
1. Evaluate the strengths and weaknesses of claims, arguments, or data.	YES	
2. Describe limitations in personal knowledge.	YES	
3. Show how common themes of science, mathematics, and technology apply in real-world contexts.	YES	
4. Describe the advantages and risks of new technologies.	YES	
5. Recognize the contributions made in science by cultures and individuals of diverse backgrounds.	YES	

### III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

**Content Standard 1: All students will apply an understanding of cells to the functioning of multicellular organisms; and explain how cells grow, develop and reproduce. (Cells)**

Middle School	Testable	Restrictions
1. Describe similarities/ differences between single-celled and multicellular organisms.	YES	
2. Explain why specialized cells are needed by plants and animals.	YES	
3. Explain how cells use food as a source of energy.	YES	

**Content Standard 2: All students will use classification systems to describe groups of living things; compare and contrast differences in the life cycles of living things; investigate and explain how living things obtain and use energy; and analyze how parts of living things are adapted to carry out specific functions. (Organization of Living Things)**

Middle School	Testable	Restrictions
1. Compare and classify organisms into major groups on the basis of their structure.	YES	
2. Describe the life cycle of a flowering plant.	YES	
3. Describe evidence that plants make and store food.	YES	
4. Explain how selected systems and processes work together in plants and animals.	YES	

**Content Standard 3: All students will investigate and explain how characteristics of living things are passed on through generations; explain why organisms within a species are different from one another; and explain how new traits can be established by changing or manipulating genes. (Heredity)**

Middle School	Testable	Restrictions
1. Describe how the characteristics of living things are passed on through generations.	YES	
2. Describe how heredity and environment may influence/determine characteristics of an organism.	YES	

**Content Standard 4: All students will explain how scientists construct and scientifically test theories concerning the origin of life and evolution of species; compare ways that living organisms are adapted (suited) to survive and reproduce in their environments; and analyze how species change through time. (Evolution)**

Middle School	Testable	Restrictions
1. Describe how scientific theory traces possible evolutionary relationships among present and past life forms.	YES	

**Content Standard 5: All students will explain how parts of an ecosystem are related and how they interact; explain how energy is distributed to living things in an ecosystem; investigate and explain how communities of living things change over a period of time; describe how materials cycle through an ecosystem and get reused in the environment; and analyze how humans and the environment interact. (Ecosystems)**

Middle School	Testable	High School
1. Describe common patterns of relationships among populations.	YES	
2. Predict the effects of changes in one population in a food web on other populations	YES	
3. Describe how all organisms in an ecosystem acquire energy directly or indirectly from sunlight.	YES	
4. Describe the likely succession of a given ecosystem over time.	YES	
5. Identify some common materials that cycle through the environment.	YES	

Middle School	Testable	High School
6. Describe ways in which humans alter the environment.	YES	
7. Explain how humans use and benefit from plant and animal materials.	YES	



#### IV. Use Scientific Knowledge from the Physical Sciences in Real-World Contexts

**Content Standard 1: All students will measure and describe the things around us; explain what the world around us is made of; identify and describe forms of energy; and explain how electricity and magnetism interact with matter. (Matter and Energy)**

Middle School	Testable	Restrictions
1. Measure physical properties of objects or substances (mass, weight, area, temperature, dimensions, volume).	YES	
2. Describe when length, mass, weight, area, or volume are appropriate to describe the size of an object or the amount of a substance.	YES	
3. Classify substances as elements, compounds, or mixtures.	YES	
4. Describe matter as consisting of extremely small particles (atoms) which bond together to form molecules.	YES	4. Don't use the word <u>bond</u> in items.
5. Describe the arrangement and motion of molecules in solids, liquids, and gases.	YES	
6. Describe energy and the many common forms it takes (mechanical, heat, light, sound, electrical, magnetic, chemical, nuclear).	YES	
7. Describe how common forms of energy can be converted, one to another.	YES	7. Conversion of energy is OK, but don't use conservation of energy.
8. Describe electron flow in simple electrical circuits.	YES	8. Don't use the word <u>electron flow</u> in items. If graphical representation, don't label positive or negative charges on batteries.
9. Use electric currents to create magnetic fields.	YES	

**Content Standard 2: All students will investigate, describe and analyze ways in which matter changes; describe how living things and human technology change matter and transform energy; explain how visible changes in matter are related to atoms and molecules; and how changes in matter are related to changes in energy. (Changes in Matter)**

Middle School	Testable	Restrictions
1. Describe common physical changes in materials: evaporation, condensation, thermal expansion, and contraction.	YES	
2. Describe common chemical changes in terms of properties of reactants and products.	YES	
3. Distinguish between physical and chemical changes in natural and technological systems.	YES	
4. Describe how waste products accumulating from natural and technological activity create pollution.	YES	
5. Explain physical changes in terms of the arrangement and motion of atoms and molecules.	YES	

**Content Standard 3: All students will describe how things around us move and explain why things move as they do; demonstrate and explain how we control the motions of objects; and relate motion to energy and energy conversions. (Motion of Objects)**

Middle School	Testable	Restrictions
1. Qualitatively describe and compare motions in three dimensions.	YES	
2. Relate changes in speed or direction to unbalanced forces in two dimensions.	YES	
3. Describe the forces exerted by magnets, electrically charged objects, and gravity.	YES	
4. Design strategies for moving objects by application of forces, including the use of simple machines.	YES	

**Content Standard 4: All students will describe sounds and sound waves; explain shadows, color, and other light phenomena; measure and describe vibrations and waves; and explain how waves and vibrations transfer energy. (Waves and Vibrations)**

<b>Middle School</b>	<b>Testable</b>	<b>Restrictions</b>
1. Explain how sound travels through different media.	YES	
2. Explain how echoes occur and how they are used.	YES	
3. Explain how light helps us to see.	YES	3. Don't use eye anatomy in items.
4. Explain how objects or media reflect, refract, transmit, or absorb light.	YES	
5. Describe the motion of pendulums or vibrating objects (frequency, amplitude).	YES	
6. Explain how waves transmit energy.	YES	

**V. Use Scientific Knowledge from the Earth and Space Sciences  
in Real-World Contexts**

**Content Standard 1: All students will describe the earth's surface; describe and explain how the earth's features change over time; and analyze effects of technology on the earth's surface and resources. (Geosphere)**

Middle School	Testable	Restrictions
1. Describe and identify surface features using maps.	YES	
2. Explain how rocks and minerals are formed.	YES	
3. Explain how rocks and fossils are used to determine the age and geological history of the earth.	YES	
4. Explain how rocks are broken down, how soil is formed and how surface features change.	YES	
5. Explain how technology changes the surface of the earth.	YES	

**Content Standard 2: All students will demonstrate where water is found on earth; describe the characteristics of water and how water moves; and analyze the interaction of human activities with the hydrosphere. (Hydrosphere)**

Middle School	Testable	Restrictions
1. Describe various forms that water takes on the earth's surface and conditions under which they exist.	YES	
2. Describe how rain water in Michigan reaches the oceans.	YES	2. Don't use words <u>tide</u> and <u>thermal layering</u> in items.
3. Describe the origins of pollution in the hydrosphere.	YES	

**Content Standard 3: All students will investigate and describe what makes up weather and how it changes from day to day, from season to season and over long periods of time; explain what causes different kinds of weather; and analyze the relationships between human activities and the atmosphere. (Atmosphere and Weather)**

Middle School	Testable	Restrictions
1. Describe the composition and characteristics of the atmosphere.	YES	
2. Describe patterns of changing weather and how they are measured.	YES	2. Illustrations must use representations of conventional system and symbols.
3. Explain the water cycle and its relationship to weather patterns.	YES	
4. Describe health effects of polluted air.	YES	

**Content Standard 4: All students will compare and contrast our planet and sun to other planets and star systems; describe and explain how objects in the solar system move; explain scientific theories as to the origin of the solar system; and explain how we learn about the universe. (Solar System, Galaxy and Universe)**

Middle School	Testable	Restrictions
1. Compare the earth to other planets in terms of supporting life.	YES	1. Don't use term <u>fall</u> when referring to "fall to planet" in objective.
2. Describe, compare, and explain the motions of planets, moons, and comets in the solar system.	YES	
3. Describe and explain common observations of the day and night skies.	YES	
4. Explain current scientific thinking about how the solar system formed.	YES	

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*High School*

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**SCIENCE**  
**CONTENT STANDARDS AND WORKING DRAFT BENCHMARKS**

**I. Construct New Scientific and Personal Knowledge**

**Content Standard 1: All students will ask questions that help them learn about the world; design and conduct investigations using appropriate methodology and technology; learn from books and other sources of information; communicate their findings using appropriate technology; and reconstruct previously learned knowledge. (Constructing New Scientific Knowledge)**

<b>High School</b>	<b>Testable</b>	<b>Restrictions</b>
1. Develop questions or problems for investigation that can be answered empirically.	YES	
2. Suggest empirical tests of hypotheses.	YES	
3. Design and conduct scientific investigations.	YES	
4. Diagnose possible reasons for failures of mechanical or electronic systems.	YES	
5. Assemble mechanical or electronic systems using appropriate tools and instructions.	NO	
6. Recognize and explain the limitations of measuring devices.	YES	
7. Gather and synthesize information from books and other sources of information.	YES	
8. Discuss topics in groups by being able to restate or summarize what others have said, ask for clarification or elaboration, and take alternative perspectives.	YES	
9. Reconstruct previously learned knowledge.	NO	

## **II. Reflect on the Nature, Adequacy and Connections Across Scientific Knowledge**

**Content Standard 1: All students will analyze claims for their scientific merit and explain how scientists decide what constitutes scientific knowledge; how science is related to other ways of knowing; how science and technology affect our society; and how people of diverse cultures have contributed to and influenced developments in science. (Reflecting on Scientific Knowledge)**

<b>High School</b>	<b>Testable</b>	<b>Restrictions</b>
1. Justify plans or explanations on a theoretical or empirical basis.	YES	
2. Describe some general limitations of scientific knowledge.	YES	
3. Show how common themes of science, mathematics, and technology apply in real-world contexts.	YES	
4. Discuss the historical development of key scientific concepts and principles.	YES	
5. Evaluate alternative long range plans for resource use and by-product disposal in terms of environmental and economic impact.	YES	
6. Describe the historical, political, and social factors affecting developments in science.	YES	



### III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

**Content Standard 1: All students will apply an understanding of cells to the functioning of multicellular organisms; and explain how cells grow, develop and reproduce. (Cells)**

High School	Testable	Restrictions
1. Classify cells/organisms on the basis of organelle and/or cell types.	YES	
2. Explain how multicellular organisms grow, based on how cells grow and reproduce.	YES	
3. Compare and contrast ways in which selected cells are specialized to carry out particular life functions.	YES	
4. Compare and contrast the chemical composition of selected cell types.	NO	
5. Compare the transformations of matter and energy during photosynthesis and respiration.	YES	
6. Explain how essential materials move into cells and how waste and other materials get out.	YES	
7. Explain how cells use food to grow.	YES	

**Content Standard 2: All students will use classification systems to describe groups of living things; compare and contrast differences in the life cycles of living things; investigate and explain how living things obtain and use energy; and analyze how parts of living things are adapted to carry out specific functions. (Organization of Living Things)**

High School	Testable	Restrictions
1. Classify major groups of organisms on the basis of the five-kingdom system.	YES	
2. Describe the life cycle of an organism associated with human disease.	YES	
3. Explain the process of food storage and food use in organisms.	YES	

High School	Testable	Restrictions
4. Explain how living things maintain a stable internal environment.	YES	

5. Describe technology used in the prevention, diagnosis, and treatment of diseases.	YES	
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**Content Standard 3: All students will investigate and explain how characteristics of living things are passed on through generations; explain why organisms within a species are different from one another; and explain how new traits can be established by changing or manipulating genes. (Heredity)**

High School	Testable	Restrictions
1. Explain how characteristics of living things are passed on from generation to generation.	YES	

2. Describe how genetic material is passed from parent to young during sexual and asexual reproduction.	YES	
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3. Explain how new traits may be established in individuals/ populations through changes in genetic material (DNA).	YES	
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**Content Standard 4: All students will explain how scientists construct and scientifically test theories concerning the origin of life and evolution of species; compare ways that living organisms are adapted (suited) to survive and reproduce in their environments; and analyze how species change through time. (Evolution)**

High School	Testable	Restrictions
1. Describe what biologists consider to be evidence for human evolutionary relationships to selected animal groups.	YES	

2. Explain how a new species or variety may originate through the evolutionary process of natural selection.	YES	
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3. Explain how new traits might arise and become established in a population.	YES	
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**Content Standard 5: All students will explain how parts of an ecosystem are related and how they interact; explain how energy is distributed to living things in an ecosystem; investigate and explain how communities of living things change over a period of time; describe how materials cycle through an ecosystem and get reused in the environment; and analyze how humans and the environment interact. (Ecosystems)**

High School	Testable	Restrictions
1. Describe common ecological relationships among species.	YES	
2. Explain how energy flows through familiar ecosystems.	YES	
3. Describe general factors regulating population size in ecosystems.	YES	
4. Describe responses of an ecosystem to events that cause it to change.	YES	
5. Describe how water, carbon dioxide, and soil nutrients cycle through selected ecosystems.	YES	
6. Explain the effects of agriculture and other human activities on selected ecosystems.	YES	

#### **IV. Use Scientific Knowledge from the Physical Sciences in Real-World Contexts**

**Content Standard 1: All students will measure and describe the things around us; explain what the world around us is made of; identify and describe forms of energy; and explain how electricity and magnetism interact with matter. (Matter and Energy)**

<b>High School</b>	<b>Testable</b>	<b>Restrictions</b>
1. Describe and compare objects in terms of mass, volume, and density.	YES	
2. Explain how families of elements are related by common properties.	YES	
3. Analyze properties of common household and agricultural materials in terms of risk/benefit balance.	YES	
4. Describe and explain the structural parts and electrical charges of atoms.	YES	
5. Describe how energy is conserved during transformations.	YES	
6. Explain changes in matter and energy involving heat transfer.	YES	
7. Describe how electric currents can be produced by interacting wires and magnets.	YES	
8. Construct and explain simple circuits using wires, light bulbs, fuses, switches, and power sources.	YES	

**Content Standard 2: All students will investigate, describe and analyze ways in which matter changes; describe how living things and human technology change matter and transform energy; explain how visible changes in matter are related to atoms and molecules; and how changes in matter are related to changes in energy. (Changes in Matter)**

<b>High School</b>	<b>Testable</b>	<b>Restrictions</b>
1. Explain how mass is conserved in physical and chemical changes.	YES	
2. Describe nuclear changes in terms of the properties of reactants and products.	YES	

High School	Testable	Restrictions
3. Trace, to an original source, the energy used by living things and machines.	YES	
4. Describe how common materials are made and disposed of or recycled.	YES	
5. Explain chemical changes in terms of the arrangement and motion of atoms and molecules.	YES	
6. Describe, compare, and contrast changes in atoms and/or molecules during physical, chemical, and nuclear changes.	YES	
7. Describe energy changes associated with physical and chemical changes.	YES	
8. Describe, compare and contrast relative magnitudes of energy changes involved in physical, chemical and nuclear changes.	YES	

**Content Standard 3: All students will describe how things around us move and explain why things move as they do; demonstrate and explain how we control the motions of objects; and relate motion to energy and energy conversions. (Motion of Objects)**

High School	Testable	Restrictions
1. Perform measurements and calculations to describe the speed and direction of an object.	YES	
2. Describe that whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first object.	YES	
3. Analyze the operation of machines in terms of force and motion.	YES	
4. Explain energy conversions in moving objects and in simple machines.	YES	

**Content Standard 4: All students will describe sounds and sound waves; explain shadows, color, and other light phenomena; measure and describe vibrations and waves; and explain how waves and vibrations transfer energy. (Waves and Vibrations)**

High School	Testable	Restrictions
1. Relate characteristics of sounds that we hear to properties of sound waves.	YES	
2. Explain how sound recording and reproducing devices work.	NO	
3. Relate colors to wavelengths of light.	YES	
4. Explain how we see colors of objects.	YES	
5. Describe different types of waves and their technological applications.	YES	
6. Describe waves in terms of their properties (frequency, amplitude, wavelength, wave velocity).	YES	
7. Describe the behavior of waves when they interact.	YES	
8. Relate changes in detected frequency of a source to the motion of the source and/or the detector.	YES	
9. Explain how energy is stored and transformed in vibrating and oscillating objects.	YES	

**V. Use Scientific Knowledge from the Earth and Space Sciences  
in Real-World Contexts**

**Content Standard 1: All students will describe the earth's surface; describe and explain how the earth's features change over time; and analyze effects of technology on the earth's surface and resources. (Geosphere)**

<b>High School</b>	<b>Testable</b>	<b>Restrictions</b>
1. Explain the surface features of the Great Lakes region using Ice Age theory.	YES	
2. Use the plate tectonics theory to explain features of the earth's surface and geological phenomena and describe evidence for the plate tectonics theory.	YES	
3. Explain how and why earth materials are conserved and recycled.	YES	

**Content Standard 2: All students will demonstrate where water is found on earth; describe the characteristics of water and how water moves; and analyze the interaction of human activities with the hydrosphere. (Hydrosphere)**

<b>High School</b>	<b>Testable</b>	<b>Restrictions</b>
1. Explain how water moves below the earth's surface.	YES	
2. Explain relationships between the hydrosphere, regional climates, and human activities.	YES	
3. Describe how human activities affect the quality of water in the hydrosphere.	YES	

**Content Standard 3: All students will investigate and describe what makes up weather and how it changes from day to day, from season to season and over long periods of time; explain what causes different kinds of weather; and analyze the relationships between human activities and the atmosphere. (Atmosphere and Weather)**

<b>High School</b>	<b>Testable</b>	<b>Restrictions</b>
1. Describe patterns of air movement in the atmosphere and how they affect weather conditions.	YES	
2. Explain and predict general weather patterns and storms.	YES	

High School	Testable	Restrictions
3. Explain changes in climate over long periods of time.	YES	

**Content Standard 4: All students will compare and contrast our planet and sun to other planets and star systems; describe and explain how objects in the solar system move; explain scientific theories as to the origin of the solar system; and explain how we learn about the universe. (Solar System, Galaxy and Universe)**

High School	Testable	Restrictions
1. Describe the position and motion of our solar system in the universe.	YES	
2. Explain why seasons occur on earth.	YES	
3. Explain how stars form and how they produce energy.	YES	
4. Explain how technology and scientific inquiry have helped us learn about the universe.	YES	